MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2016/2017

ETM7146 - SWITCHING AND NETWORKING TECHNIQUES AND SYSTEMS

(All section / Groups)

15 OCT 2016
9:00 A.M- 12:00 P.M.
(3 Hours)

INSTRUCTION TO STUDENT

1. This Question paper consists of 7 pages including cover page with 4 Questions only.

2. Attempt all **FOUR** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print all your answers in the answer Booklet provided.

Question 1

(a) Voice call traffic intensity in circuit-switched networks is measured in terms of Erlang (*E*). Define the unit, *E*, for networks with analog lines. How do we define or quantify *E* for the networks with digital lines?

[6 marks]

(b) As an engineer, you are asked to design a telephone trunking system for a new building that is being developed. The building is expected to serve 150 companies. Each company is expected to have an average of 70 outgoing calls and 50 incoming calls. Each call takes an average of 2 minutes. Find:

(i) The outgoing and incoming traffics for each company.

[2 marks]

(ii) The outgoing and incoming traffics for the whole building.

[2 marks]

(iii) Total occupancy of the line for the whole building.

[1 marks]

(iv) The outgoing, incoming and total traffic lost if the outgoing calls have 3 calls lost and the incoming calls have 1 call lost for each company.

[3 marks]

(v) The grade of service for each incoming and outgoing trunks.

[3 marks]

(c) In Figure 1(c), group of trunks are to be dimensioned to provide a grade of service of 0.002 under normal load and 0.008 under 20% overload. For what range of nominal traffic loads does the normal load criterion apply and when does the overload criterion apply?

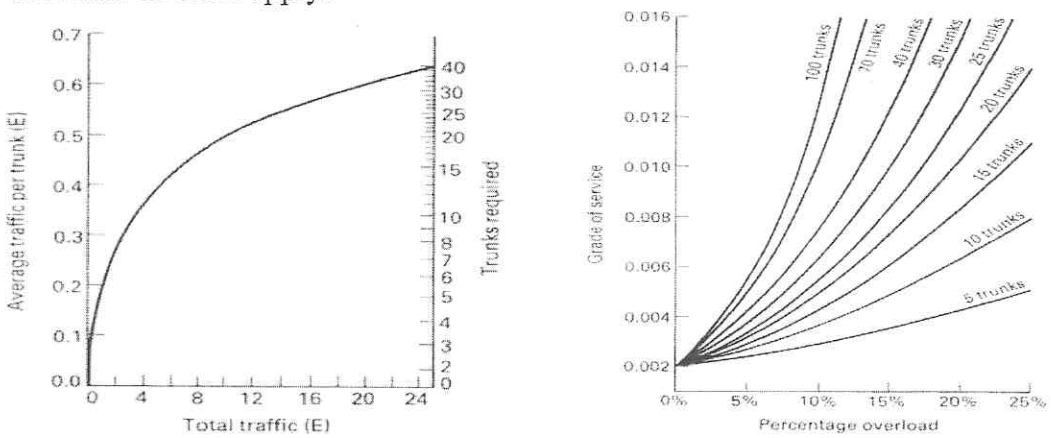

Figure 1(c)

[4 marks]

(d) Briefly explain the trunking concept and how it is implemented in the hierarchical public switched telephone network (PSTN).

[4 marks]

Continued...

Question 2

(a) List down TWO (2) main drawbacks for in-channel signalling systems. How does common channel signalling (CCS) technique resolve the issues?

[4 marks]

(b) Given that a single-stage switching network with 25 incoming and outgoing trunks respectively, find:

(i) What is the maximum number of simultaneous calls?

(ii) What does it mean by full-availability? Discuss the term with respect to the given switching network. [2 marks]

(iii) Calculate the percentage of crosspoints usage at high load. Comment on your result. [2 marks]

[3 marks]

(iv) Say that by using two-group gradings, the availability of the switching network is 15. Draw the full diagram and the grading diagram.
[Given: $k = s+c$, $N = 2s + c$
where k= availability, s = number of singles, c = number of commons, N =number of trunks]

[4 marks]

(c) Signaling System 7 (SS7) is an international standard used in Integrated Services for Digital Network (ISDN). Design a typical SS7 network topology which consists of all these items: node basic rate interface (BRI), Private branch exchange (PBX), primary rate interface (PRI), service control point (SCP), service switching point (SSP) and signaling transfer point (STP). In your design, it should contain 2 points for each node.

[6 marks]

(d) In an Open Systems Interconnection model (OSI) model, physical layer is concern on the physical interface between devices and the rules by which bits are passed from one to another. Describe the FOUR (4) important characteristics of the physical layer.

[4 marks]

Continued...

Question 3

(a) Draw a network for the following physical / medium access control (MAC) addressing scenario in a bus architecture:

"There are 4 computer stations (node) with physical address 10, 28, 53 and 87, respectively. The 4 nodes are connected by a link which is of type bus topology local area network (LAN). The computer with physical address 10 is the sender, and the computer with physical address 87 is the receiver. During transmission, it is found that destination address does not match with a node with physical address 28, 53, thus the packet is dropped. Finally, a node with physical address 10 successfully sends a frame to a node with physical address 87.

[4 marks]

(b) A pure ALOHA network transmits 200-bit frames on a shared channel of 200 kbps. Answer the following:

(i) Find the average frame transmission time.

(ii) Find the vulnerable time. [1 mark]

(iii) What is the requirement to make this frame collision-free? [1 mark]

(iv) By using a diagram, show all the relevant items that highlighted in (b)(i), (b)(ii) and (b)(iii). [2 marks]

[4 marks]

Continued...

(c) Figure Q3(c) illustrates a typical example of the data network architecture of two companies located in a same building.

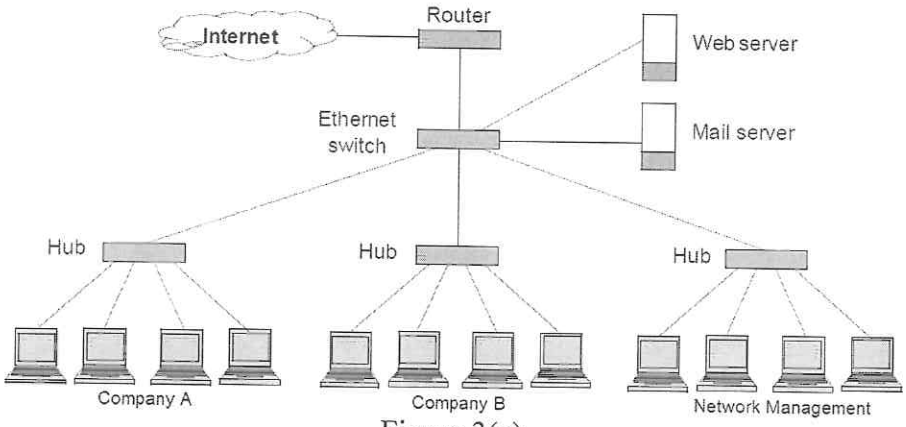

Figure 3(c)

(i) Determine the collision range of each computer terminal.

[2 marks]

(ii) Suppose that the Ethernet switch in Figure Q3(c) is replaced by a hub. What is the new collision range ?

[1 mark]

(iii) What are the main differences between a router and an Ethernet switch? What are the advantages and disadvantages in replacing the Ethernet switch with a router in the network shown in Figure Q3(c) ?

[4 marks]

(d) Fragmentation is a phenomenon in which storage space is used inefficiently, reducing capacity or performance. Show a fragmentation internet protocol version 4 (IPV4) datagram with 4000 bytes of data, where the original datagram is fragmented into 3 fragments while fragment 2 is having 2 subfragments. Given that identification is 14,567 and total length of 4020 of original datagram.

[6 marks]

Continued...

Question 4

(a) Forwarding means to place the packet in its route to its destination. Forwarding requires a host or a router to have a routing table. Design and draw a simple network that consist of 2 hosts and 2 routers that follow both 'route method' and 'next-hop method' of forwarding. Shows related routing tables.

[6 marks]

(b) Assuming in a remote learning classroom, video lectures are conducted over a packet switched network such as the Internet. As a network engineer overseeing the setup of this network, you have chosen to use a virtual circuit (VC) approach to setup this system. Draw a suitable VC diagram to suit with this scenario and write a summary of your design choice.

[6 marks]

(c) Suppose that you are designing an application-layer protocol for reliable data transfer for your company network. Assume that the end-to-end communication paths in the network are rather reliable.

(i) Suppose that the protocol will be used by applications that have plenty of data to send. Discuss whether a positive acknowledgement or a negative acknowledgement reliable data transfer mechanism is more suitable for your protocol.

[3 marks]

(ii) Which transport protocol should be use in your design ? Why?

[3 marks]

(d) Figure Q4(d) shows a weighted graph with six nodes (labelled v1 to v6). By using the Dijkstra's shortest path algorithm, generate the least-cost path tree from node 6 to all other nodes.

[7 marks]

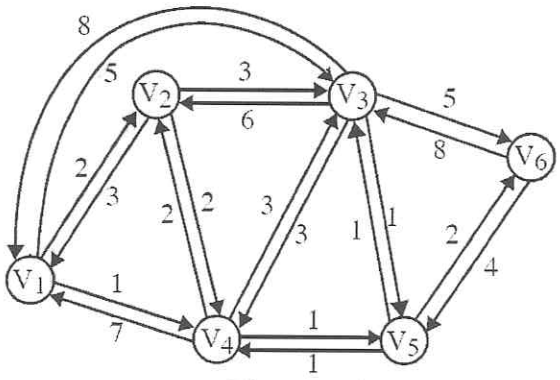

Figure 4(d)

End of Paper

Appendix

Number of trunks	1 lost call in 50 (0.02)	100 (0.01)	200 (0.005)	1000 (0.001)	Number of trunks	1 lost call in 50 (0.02)	100 (0.01)	200 (0.005)	1000 (0.001)
	E	*E*	*E*	*E*		*E*	*E*	*E*	*E*
1	0.020	0.010	0.005	0.001	51	41.2	38.8	36.8	33.4
2	0.22	0.15	0.105	0.046	52	42.1	39.7	37.6	34.2
3	0.60	0.45	0.35	0.19	53	43.1	40.6	38.5	35.0
4	1.1	0.9	0.7	0.44	54	44.0	41.5	39.4	35.8
5	1.7	1.4	1.1	0.8	55	45.0	42.4	40.3	36.7
6	2.3	1.9	1.6	1.1	56	45.9	43.3	41.2	37.5
7	2.9	2.5	2.2	1.6	57	46.9	44.2	42.1	38.3
8	3.6	3.2	2.7	2.1	58	47.8	45.1	43.0	39.1
9	4.3	3.8	3.3	2.6	59	48.7	46.0	43.9	40.0
10	5.1	4.5	4.0	3.1	60	49.7	46.9	44.7	40.8
11	5.8	5.2	4.6	3.6	61	50.6	47.9	45.6	41.6
12	6.6	5.9	5.3	4.2	62	51.6	48.8	46.5	42.5
13	7.4	6.6	6.0	4.8	63	52.5	49.7	47.4	43.4
14	8.2	7.4	6.6	5.4	64	53.4	50.6	48.3	44.1
15	9.0	8.1	7.4	6.1	65	54.4	51.5	49.2	45.0
16	9.8	8.9	8.1	6.7	66	55.3	52.4	50.1	45.8
17	10.7	9.6	8.8	7.4	67	56.3	53.3	51.0	46.6
18	11.5	10.4	9.6	8.0	68	57.2	54.2	51.9	47.5
19	12.3	11.2	10.3	8.7	69	58.2	55.1	52.8	48.3
20	13.2	12.0	11.1	9.4	70	59.1	56.0	53.7	49.2
21	14.0	12.8	11.9	10.1	71	60.1	57.0	54.6	50.1
22	14.9	13.7	12.6	10.8	72	61.0	58.0	55.5	50.9
23	15.7	14.5	13.4	11.5	73	62.0	58.9	56.4	51.8
24	16.6	15.3	14.2	12.2	74	62.9	59.8	57.3	52.6
25	17.5	16.1	15.0	13.0	75	63.9	60.7	58.2	53.5
26	18.4	16.9	15.8	13.7	76	64.8	61.7	59.1	54.3
27	19.3	17.7	16.6	14.4	77	65.8	62.6	60.0	55.2
28	20.2	18.6	17.4	15.2	78	66.7	63.6	60.9	56.1
29	21.1	19.5	18.2	15.9	79	67.7	64.5	61.8	56.9
30	22.0	20.4	19.0	16.7	80	68.6	65.4	62.7	58.7
31	22.9	21.2	19.8	17.4	81	69.6	66.3	63.6	58.7
32	23.8	22.1	20.6	18.2	82	70.5	67.2	64.5	59.5
33	24.7	23.0	21.4	18.9	83	71.5	68.1	65.4	60.4
34	25.6	23.8	22.3	19.7	84	72.4	69.1	66.3	61.3
35	26.5	24.6	23.1	20.5	85	73.4	70.1	67.2	62.1
36	27.4	25.5	23.9	21.3	86	74.4	71.0	68.1	63.0
37	28.3	26.4	24.8	22.1	87	75.4	71.9	69.0	63.9
38	29.3	27.3	25.6	22.9	88	76.3	72.8	69.9	64.8
39	30.1	28.2	26.5	23.7	89	77.2	73.7	70.8	65.6
40	31.0	29.0	27.3	24.5	90	78.2	74.7	71.8	66.6
41	32.0	29.9	28.2	25.3	91	79.2	75.6	72.7	67.4
42	32.9	30.8	29.0	26.1	92	80.1	76.6	73.6	68.3
43	33.8	31.7	29.9	26.9	93	81.0	77.5	74.3	69.1
44	34.7	32.6	30.8	27.7	94	81.9	78.4	75.4	70.0
45	35.6	33.4	31.6	28.5	95	82.9	79.3	76.3	70.9
46	36.6	34.3	32.5	29.3	96	83.8	80.3	77.2	71.8
47	37.5	35.2	33.3	30.1	97	84.8	81.2	78.2	72.6
48	38.4	36.1	34.2	30.9	98	85.7	82.2	79.1	73.5
49	39.4	37.0	35.1	31.7	99	86.7	83.2	80.0	74.4
50	40.3	37.9	35.9	32.5	100	87.6	84.0	80.9	75.3